Available online at ijci.wcci-international.org

International Journal of Curriculum and Instruction 18(1) (2026) 91–106

IJCI
International Journal of Curriculum and Instruction

Lucky Force: Developing and Evaluating a Card and Board Game for Enhancing Physics Concept

Aldrin B. Boocan [a] *, Caryn A. Gumihid [a], Crisha Jean B. Lara [a] ,Justine Grace R. Mendoza [a] , Christzon P. Pasigon [a]

[a] *Ifugao State University Potia Campus, Potia, Alfonso Lista 3608, Philippines*

Abstract

This study developed and evaluated *Lucky Force*, a curriculum-aligned card and board game designed to enhance Grade 8 students' understanding of net force. The research employed a Research and Development (R&D) design with a descriptive–evaluative approach and purposive sampling to select participants capable of providing expert and pedagogical feedback. Participants included 50 Bachelor of Secondary Education Science majors from Ifugao State University–Potia Campus and 10 experienced science teachers from various high schools in Ifugao province. The game integrated core physics concepts—particularly Newton's Second Law, friction, and acceleration—into interactive gameplay to address common misconceptions in force and motion. Evaluation utilized researcher-made and adapted questionnaires assessing rules and mechanics, design, conceptual accuracy, playability and playfulness, goals and objectives, components and organization, and overall usefulness, rated on a 5-point Likert scale. Results revealed uniformly high ratings, with overall mean scores of 4.67 from students and 4.84 from teachers, both interpreted as *Excellent*. These findings indicate that *Lucky Force* effectively promotes conceptual mastery, engagement, and collaborative learning in physics education. The study recommends further validation through quasi-experimental research to assess learning outcomes and scalability for classroom integration.

Keywords: game-based learning; net force; science education; instructional materials; physics misconceptions

1. Introduction

Science education is essential in fostering critical thinking, community involvement, and country advancements (De Melo et al., 2020). In the Philippines, access to quality education remains unequal in emerging nations, where higher socioeconomic backgrounds have a greater chance of access (Alams, 2023). In the 2022 PISA results, the Philippines ranked 78th out of 80

* Corresponding author name. ORCID ID.: https://orcid.org/0000-0000-0000-0000
E-mail address: chrp_pasigon@ifsu.edu.ph

participating countries and economies in terms of student performance in science, with 77.2% of students performing below the basic proficiency level (OECD, 2023).

Persistent misconceptions regarding force and motion hinder students' mastery of fundamental physics concepts. Many fail to understand acceleration as a vector quantity fully and struggle to explain the relationship between acceleration and the force that causes it (Sarkim, 2024). Common misunderstandings include the belief that acceleration always aligns with the direction of motion, or that force is the same as speed (Liu & Fang, 2016; Métioui & Trudel, 2021). Such misconceptions are present across different age groups and educational backgrounds, with only slight decreases in upper grades (Bouzid et al., 2022). These gaps extend to the concept of net force, which is essential in determining an object's state of equilibrium (Hejazi & Chun, 2020).

The K-12 Science Curriculum Guide (2016) emphasizes the importance of science education that effectively applies skills by structuring the curriculum around real-world situations and problems (Balagtas et al., 2019). However, the study of Sari et al. (2018) shows that students struggle significantly in understanding and applying formula-based concepts in science. Engagement is critical to overcoming these difficulties, and game-based learning (GBL) offers a promising strategy. GBL incorporates interactive elements, challenges, and feedback to enhance motivation and deepen conceptual understanding (Wu, 2015; Chen et al., 2021). Board games, in particular, have been shown to improve motivation, knowledge retention, and collaboration in science learning (Lin et al., 2019; Ezezika et al., 2021).

Despite these benefits, GBL implementation faces challenges, including complex design, limited resources, and inconsistent integration in classroom practice (Mikrouli et al., 2024; Molin, 2017). Effective GBL requires rigorous design frameworks and systematic evaluation to ensure educational impact (Sasupilli et al., 2019). In response to these challenges, this study aims to develop and evaluate *Lucky Force*, a card and board game designed to improve Grade 8 students' understanding of net force. The game integrates curriculum-aligned physics content with interactive, collaborative gameplay to address misconceptions and enhance engagement, as observed among students at Namilangan National High School (M. R. B. Vicente, Personal Communication, May 27, 2025).

This study aims to develop and evaluate the game specifically, it seeks to: (1) develop a game-based activity called *Lucky Force*; (2.1) evaluate the game

based on its rules and mechanics; (2.2) assess the design of the game in terms of graphics, size, color, font size, font style, physical quality and durability, and card uniformity; (3) determine the conceptual accuracy of the game by examining its relatedness to the learning objective and the accuracy of its content; (4) evaluate its playability and playfulness; (5) assess its goals and objectives; (6) examine its components and organization; and (7) determine its overall usefulness as an instructional tool.

2. Method

2.1. Research Design

2.1.1. This study employed a Research and Development (R&D) design with a descriptive–evaluative approach to create, refine, and assess the Lucky Force card and board game. The process involved designing the game based on curriculum standards, identifying gaps in students' understanding of Net Force, developing the game's components to ensure both pedagogical soundness and user-friendliness, and evaluating its features, conceptual accuracy, and educational value through feedback from students and teachers. This design enabled the systematic transformation of physics concepts into an engaging interactive format while incorporating iterative improvements based on stakeholder input.

2.2. Participants

A total of 60 participants were involved in the study, comprising 50 Bachelor of Secondary Education (BSED) Science majors from Ifugao State University, Potia Campus, and 10 experienced science teachers from various high schools in Ifugao province. The student group included Science 2 (N = 15), Science 3 (N = 19), Science 4 pre-service teachers (N = 16), and two science graduates. Participants were purposively selected for their familiarity with physics concepts and their ability to provide relevant feedback on the Lucky Force game.

2.3. Sampling Procedure

Purposive sampling was employed to select participants with relevant expertise and learning experience in science. This ensured that feedback on the *Lucky Force* game would address both pedagogical and conceptual aspects. Student participants were drawn from BSED Science classes at Ifugao State University, Potia Campus, while teacher participants were selected from various high schools in Ifugao province based on their experience in teaching science.

Permission to conduct the study was obtained from institutional heads prior to recruitment.

2.4. Data collectioninstruments

Two primary instruments were used to evaluate *Lucky Force*:

1. Researcher-Made Questionnaires – Developed to assess the rules and mechanics of the game, its design (graphics, size, color, font size, font style, physical quality and durability, card uniformity), and conceptual accuracy (relatedness to the learning objective, accuracy of content). These instruments were created because no suitable existing tools were available for these specific features.
2. Adapted Questionnaires – Items evaluating playability and playfulness, and goals and objectives, were adapted from Singh et al. (2021). Items assessing components and organization, and usefulness, were adapted from Sardinola et al. (2025).

All instruments employed a 5-point Likert scale for responses and underwent expert validation to ensure content clarity, appropriateness, and relevance.

2.5. Procedure

Permission to conduct the study was first obtained from the Dean of the College of Education and the principals of the participating schools. Participants were briefed on the study's objectives and procedures, and informed consent was secured. The evaluation instrument was distributed via Google Forms. Student participants attended structured gameplay sessions where *Lucky Force* was introduced, its rules explained, and the mechanics demonstrated. They then played the game in small groups under the supervision of the researchers. After the sessions, students completed the evaluation questionnaire through google forms based on their gameplay experience, while science teacher participants reviewed and answered the same instrument to test its reliability. All responses were collected, stored securely, and prepared for analysis.

2.6. Description Card/Board Game and its Rules/Mechanics

The development of "Lucky force" is a card/board game that enhances the understanding of Net Force concepts to develop critical thinking.

Force cards (2 Types) 140 cards

Direction cards

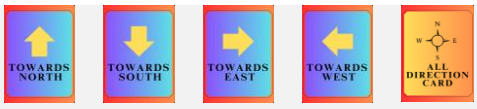

Figure 1: Sample pictures of Cards of Lucky Force

In separate decks

Direction Cards (50) – Cards used to point the direction you want your object to move.

North card – 10

South card – 10

East card – 10

West card – 10

All direction card – 10

Newton Cards (60) – Cards used to apply force for your object to move.

1N – 4, 2N – 5, 3N – 6, 4N – 7, 5N – 8, 6N – 8, 7N – 7, 8N – 6, 9N – 5, 10N – 4

The Playing Zone/ Board

The size of the board is 16 by 16 inches. The game is set in 4 different paths color color-coded with different patterns and friction value and acceleration value. All paths start at the center, where all objects will start. The friction value (N) is different in every path, same goes for the acceleration value (m/s).

Arrows are drawn on the outer side of the playing zone to indicate the directions of each path. The players will use the formula F=m x a indicated on the right side of the board to compute the force needed.

Figure 2: Sample Board of Lucky Force

The Chip/s

The size of the chip is 0.75 by 0.75 inches. The chip is considered the "object" that players use to move within the tiles. Each chip has varying mass, ranging from 1 kg to 3 kg.

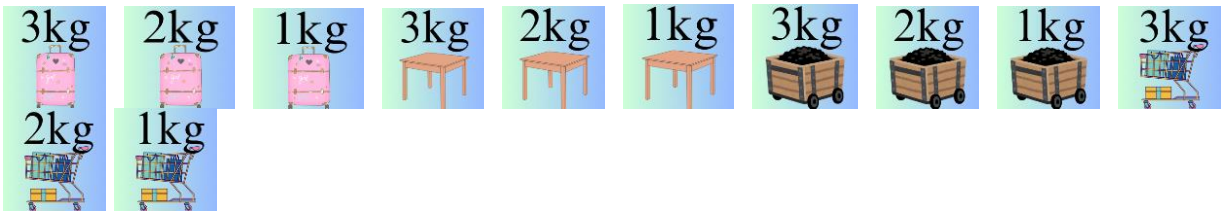

Figure 3: Sample object mass of Lucky Force

Goal of the Game

Players must strategically combine force cards with direction cards to push their objects to the last tile/ goal tile to win the game.

Rules of the Game

How to play

Players will shuffle each deck (Direction cards and Force cards).

Players will also randomly draw chip objects with varied mass to decide which object they are going to use in the game. After getting their assigned objects, players will place all objects on the starting line, which is the center.

At the beginning of the round, players are given only two cards from each deck as starting cards, 1 direction card and 1 Newton card.

During the first rotation, and every rotation, players will draw 1 card from the direction deck and 1 card from the Newton deck. Players are only allowed a maximum of 4 cards in their hand; if they have more than 4 cards, they discard a card/s of their choice and reshuffle them into their respective deck.

Players are only allowed two moves per round. However, they can pass their turn if they don't have cards to play or choose not to. Players can use their 2 moves to return any card/s to any deck (direction or Newton cards) to change their playing cards. Simply place the card/s at the bottom and pick new card/s at the top of any deck.

Regarding the direction of movements, players should always base it on the direction of the tiles on the board, not where they're facing.

To move your object, you must compute F=mxa to know how much force you need to use to move your object. To calculate if your object will move after applying force, add the tile friction to your applied force. If the player's playing cards have fewer Newton cards with the calculated force needed, you can't move your object. If the total is equal to or higher you can move your object. Also, if the player does not have the right direction cards, the object cannot move to the next tile/s. Therefore, a pair of 1 Newton card and 1 direction is considered one move. Players can use their one move to add 1 newton card to have a higher newton value for the object to move.

Booster move: Players can move two or three tiles in each turn as long as the player's playing cards are possible for that move. However, players cannot move to the next tile with different acceleration and friction, even if they have extra steps. You're forced to stop at the end of your current tile path.

2.7. Data Analysis

Data from the questionnaires were analyzed using descriptive statistics, specifically the mean, to evaluate the game's features in terms of rules and mechanics, design, conceptual accuracy, playability and playfulness, goals and objectives, components and organization, and usefulness through the use of Jamovi software. A 5-point Likert scale was used to measure responses, with qualitative descriptions assigned to each range for interpretation. This Likert Scale will be used to identify the respondent's preference or agreement regarding the statements or indicators provided. Respondents will rate using the five-point scale (McLeod, 2023). The respondents will check the corresponding box of indicators based on their preferences and experience. Responses will be measured in terms of the following degrees:

Table 1: Mean score interpretation and descriptions

Range	Description	Interpretation
4.21-5.00	The aspect is outstanding, achieving 100% effectiveness and exceeding expectations. Everything is clear, accurate, and very well-executed. No improvements are needed.	EXCELLENT
3.40-4.20	The aspect is well done, reaching approximately 75% effectiveness and meeting expectations. It is clear and compelling, with only minor room for improvement.	VERY SATISFACTORY
2.81-3.40	The aspect is acceptable, demonstrating 55% effectiveness, and meets basic standards. However, there is noticeable room for improvement.	SATISFACTORY
1.81-2.60	The aspect needs improvement, showing only 25%. Several issues affect clarity, usefulness, or effectiveness.	GOOD
1.00-1.80	The aspect is unacceptable or ineffective, with 0% effectiveness. Significant issues are present that significantly hinder understanding or performance.	POOR

2.8. Ethical Considerations

Prior to data collection, a formal request to conduct the study was submitted to the Dean of the College of Education and the principals of the participating schools. All participants were informed of the study's objectives, procedures, and their role in the research, and informed consent was obtained. Participation was voluntary, and confidentiality was maintained by limiting access to the collected data to the researchers and authorized personnel only. Data were stored securely in MS Excel files and used solely for research purposes, with no identifying information disclosed in any report or publication.

3. Results

3.1. Science Students

Fifty students accomplished the evaluation of the Lucky Force card/board game in terms of: 1) Rules and Mechanics; 2) Design; 3) Conceptual accuracy of the game; 4) Playability and Playfulness; 5) Goals and Objectives; 6) Components and organisation; and 7) Usefulness.

Table 2: RULES & MECHANICS OF THE GAME

Indicator	Mean	Interpretation
The rules of the game are clear and understandable.	4.36	Excellent
The rules facilitate a smooth and logical flow of the game.	4.40	Excellent
I like the complexity of the game mechanic.	4.48	Excellent
The rules/mechanics of the game are fair.	4.68	Excellent
The game mechanics are effective in helping me to understand the concept of net force.	4.40	Excellent
Avage Mean	4.46	Excellent

The rules and mechanics of the game were very well-received, earning an "Excellent" average mean score of (mean=4.46). All specific indicators were rated highly: players found the rules clear (mean=4.36) and the game flow smooth (mean=4.40). The game's complexity was appreciated (mean=4.48), and its fairness was particularly strong (mean=4.68). The mechanics were also highly effective in teaching the concept of net force (mean=4.40).

Table 3: Design of The Game

Indicator	Mean	Interpretation
The visual is appealing to the eyes.	4.70	Excellent
The card/board designs and symbols are clear and understandable.	4.56	Excellent
The color used in the card/board is clear.	4.68	Excellent
The size of the card/board is good.	4.80	Excellent
The words are readable.	4.68	Excellent
Average Mean	**4.68**	**Excellent**

The design of the game received consistently high ratings, with all indicators interpreted as Excellent. Visual appeal scored (mean=4.70), clarity of designs and symbols (mean=4.56), color clarity (mean=4.68), size appropriateness (mean=4.80), and readability of words (mean=4.68). The overall average mean for design is (mean=4.68), categorized as Excellent.

Table 3.1: Graphics

Indicator	Mean	Interpretation
The pictures and visuals on all the cards/boards look clear and consistently well-printed.	4.62	Excellent
The artwork and design style are consistent across every card in the game.	4.62	Excellent
I can always easily tell what's happening or what a card means just by looking at its pictures.	4.26	Excellent
The graphics on the cards/board never make it hard to understand how to play the game.	4.48	Excellent
Overall, the visuals on the cards/board are always appealing and look professionally made.	4.62	Excellent
Average Mean	**4.52**	**Excellent**

The graphics of the game received high evaluations across all indicators, each interpreted as Excellent. Clarity and print quality of pictures scored (mean=4.62), consistency of artwork and design style (mean=4.62), ease of understanding card meaning through visuals (mean=4.26), graphics not hindering gameplay (mean=4.48), and overall visual appeal and professionalism (mean=4.62). The overall average mean for graphics is (mean=4.52), categorized as Excellent.

Table 3.2: Size

Indicator	Mean	Interpretation
The numbers and words printed on the cards/board are always a good size and easy to read.	4.59	Excellent
Important symbols or icons on the cards/board are consistently big enough to see and understand easily.	4.67	Excellent
Everything printed on the cards/board (picture, text, numbers) always seems to be the right size compared to each other.	4.57	Excellent
I never have to squint or struggle to see details on the cards/board because of their size.	4.51	Excellent
The size of the printed elements consistently helps me play the game comfortably.	4.63	Excellent
Average Mean	4.59	Excellent

The size of the game elements was rated Excellent across all indicators. Readability of numbers and words scored (mean=4.59), visibility of symbols/icons (mean=4.67), proportional sizing of pictures, text, and numbers (mean=4.57), ease of seeing details (mean=4.51), and comfort in gameplay due to size (mean=4.63). The overall average mean for size is (mean=4.59), interpreted as Excellent.

Table 3.3: Color

Indicator	Mean	Interpretation
The colors used on the cards/board consistently help me tell different types of cards or game elements apart.	4.44	Excellent
The colors on all the cards/board always look the same and consistent.	4.66	Excellent
Important information is always printed in colors that are easy to read against the card/board background.	4.58	Excellent
The colors on the cards/board never confuse me about what a card does or represents.	4.50	Excellent
The way colors are used on the cards/board consistently makes the game easy to understand.	4.58	Excellent
Average Mean	4.55	Excellent

The color used in the game was rated Excellent on all indicators. Differentiation of card types scored (mean=4.44), color consistency (mean=4.66), readability of important information (mean=4.58), clarity in card meaning (mean=4.50), and contribution to game understanding (mean=4.58). The overall average mean for color is (mean=4.55), interpreted as Excellent.

Table 3.4: Font Size

Indicator	Mean	Interpretation
All the words and numbers printed on the cards/board are always big enough for me to read easily.	4.44	Excellent
The font size never changes in a way that makes text on certain cards/boards hard to see.	4.70	Excellent
I can easily understand what's happening or what a card/board means just by looking at it.	4.44	Excellent
The text size consistently helps me quickly read and understand what's written on the cards/board.	4.52	Excellent
Every piece of writing on the cards/board is consistently clear because of its size.	4.50	Excellent
Average Mean	4.52	Excellent

Font size was rated Excellent across all indicators. Readability of words and numbers scored (mean=4.44), consistency of font size (mean=4.70), ease of understanding card meaning (mean=4.44), support for quick reading (mean=4.52), and clarity of all text (mean=4.50). The overall average mean for font size is (mean=4.52), interpreted as Excellent.

Table 3.5: Font Style

Indicator	Mean	Interpretation
The style of the letters and numbers (the font) used on the cards/board is always easy to read.	4.56	Excellent
The font style consistently fits the game's overall theme and design.	4.74	Excellent
All letters and symbols written in the chosen font style are always clear and distinct from one another.	4.72	Excellent
I can always quickly read and understand the text on the cards/board because of the font style.	4.68	Excellent
The font style used for all text on the cards/board is consistently clear and never distracting.	4.62	Excellent
Average Mean	4.66	Excellent

Font style received Excellent ratings across all indicators. Readability of letters and numbers scored 4.56, suitability to game theme 4.74, clarity and distinction of letters and symbols 4.72, ease of quick reading 4.68, and overall

clarity without distraction 4.62. The overall average mean for font style is 4.66, interpreted as Excellent.

Table 3.6: Physical Quality and Durability

Indicator	Mean	Interpretation
The card/board material feels consistently sturdy across all cards/boards.	4.61	Excellent
The cards maintain their shape and flatness well even after being handled or shuffled.	4.67	Excellent
All game components demonstrate consistent manufacturing quality.	4.76	Excellent
All cards/board have consistently smooth and uniform edges.	4.67	Excellent
The cards/board and components are consistently pleasant to handle during gameplay.	4.71	Excellent
Average Mean	**4.68**	**Excellent**

Physical quality and durability of the game components were rated Excellent across all indicators. Sturdiness of materials scored (mean=4.61), shape and flatness retention (mean=4.67), manufacturing quality (mean=4.76), smoothness and uniformity of edges (mean=4.67), and handling comfort (mean=4.71). The overall average mean for physical quality and durability is (mean=4.68,) interpreted as Excellent.

Table 3.7: Card/Board Uniformity

Indicator	Mean	Interpretation
All cards/board have consistently smooth and uniform edges.	4.68	Excellent
The size of all cards/board is consistently identical, preventing any from standing out.	4.72	Excellent
The finish (e.g., gloss, matte) on the cards is consistently applied to every card/board.	4.78	Excellent
There are no noticeable differences in the thickness or feel between different cards/board.	4.72	Excellent
The backs of all cards are consistently identical, ensuring fair drawing and play.	4.82	Excellent
Average Mean	**4.74**	**Excellent**

Card/board uniformity received Excellent ratings on all indicators. Smoothness and uniformity of edges scored (mean=4.68), consistent size (mean=4.72), uniform finish application (mean=4.78), consistent thickness and feel (mean=4.72), and identical card backs (mean=4.82). The overall average mean for card/board uniformity is (mean=4.74), interpreted as Excellent.

Table 4: Conceptual Accuracy of the Game

Indicator	**Mean**	**Interpretation**
The concepts presented in the game are scientifically accurate	4.66	Excellent
The game uses correct scientific terms and principles.	4.76	Excellent
The examples and scenarios reflect real and accurate science applications.	4.62	Excellent
The explanations and information in the game are clear and free from misconceptions.	4.62	Excellent
The game effectively demonstrates the correct application of scientific ideas.	4.72	Excellent
The game's activities consistently help me understand concepts related to force.	4.70	Excellent
Playing the game consistently builds my confidence in understanding physics concepts.	4.72	Excellent
The core ideas of force are clearly and correctly demonstrated throughout the game.	4.70	Excellent
The game reinforces what I've learned about force in science class.	4.70	Excellent
The way force concepts are presented in the game feels scientifically sound.	4.72	Excellent
The game's approach to teaching force is innovative and effective.	4.70	Excellent
The game consistently helps me understand the effects of different forces.	4.74	Excellent
Average Mean	**4.69**	**Excellent**

The conceptual accuracy of the game was rated Excellent across all indicators. Scientific accuracy of concepts scored (mean=4.66), correct use of scientific terms (mean=4.76), realism of examples and scenarios (mean=4.62), clarity and correctness of explanations (mean=4.62), effective demonstration of scientific ideas (mean=4.72), consistent support for understanding force concepts (mean=4.70), confidence building in physics understanding (mean=4.72), clear and correct demonstration of core force ideas (mean=4.70), reinforcement of classroom learning (mean=4.70), scientific soundness of concept presentation (mean=4.72), innovation and effectiveness in teaching force (mean=4.70), and consistent aid in understanding force effects (mean=4.74). The overall average mean for conceptual accuracy is (mean=4.69), interpreted as Excellent.

Table 4.1: Relatedness to the Learning Objective

Indicator	Mean	Interpretation
The game activities directly help me understand the concept of net force.	4.64	Excellent
Playing the game clarifies my understanding of how forces combine.	4.72	Excellent
The game consistently helps me understand the effects of different forces.	4.74	Excellent
The game design is aimed at teaching about how forces act.	4.76	Excellent
The game's challenges and goals are directly related to mastering force concepts.	4.80	Excellent
Average Mean	**4.73**	**Excellent**

Relatedness to the learning objective received Excellent ratings across all indicators. Help in understanding net force scored (mean=4.64), clarification of force combination (mean=4.72), support in understanding force effects (mean=4.74), alignment of game design with force concepts (mean=4.76), and relevance of challenges and goals to mastering force (mean=4.80). The overall average mean for relatedness to the learning objective is (mean=4.73), interpreted as Excellent.

Table 4.2: ACCURACY OF THE CONTENT

Indicator	**Mean**	**Interpretation**
All physics information and concepts presented in the game are scientifically correct.	4.54	Excellent
The game's rules and mechanics accurately reflect the principles of force and motion.	4.62	Excellent
The examples of forces in the game are physically accurate.	4.82	Excellent
The game consistently presents concepts in a way that avoids common misconceptions about force.	4.76	Excellent
The outcomes and effects within the game, based on forces, are consistently true to established physics laws.	4.86	Excellent
Average Mean	**4.72**	**Excellent**

Accuracy of the content was rated Excellent across all indicators. Scientific correctness of physics information scored (mean=4.54), accuracy of rules and mechanics (mean=4.62), physical accuracy of force examples (mean=4.82), avoidance of misconceptions (mean=4.76), and consistency of outcomes with physics laws (mean=4.86). The overall average mean for accuracy of the content is (mean=4.72), interpreted as Excellent.

Table 5: Playability and Playfulness Adapted from the study of (Singh et al., 2021)

Indicator	Mean	Interpretation
The game provides an opportunity for healthy competition and cooperation.	4.70	Excellent
The rules of the game provide players with equal conditions for fair play.	4.76	Excellent
The rules of the game provide a set of options for flexibility in making decisions when playing the game.	4.74	Excellent
Playing the game was fun	4.86	Excellent
Average Mean	4.77	Excellent

Playability and playfulness indicators all received Excellent ratings. Opportunity for healthy competition and cooperation scored (mean=4.70), fairness

of rules (mean=4.76), flexibility in decision-making (mean=4.74), and overall fun in playing the game (mean=4.86). The overall average mean for playability and playfulness is (mean=4.77), interpreted as Excellent.

Table 6: Goals and Objectives Adapted from the study of (Singh et al., 2021)

Indicator	Mean	Interpretation
The purpose and rationale for the game are fully explained.	4.78	Excellent
The goals and objectives of the game are clearly defined.	4.72	Excellent
The game was thought-provoking.	4.84	Excellent
The game encouraged student interaction.	4.76	Excellent
The game promoted discussion of key topics.	4.82	Excellent
The card game helps with my recall of concepts/terms.	4.78	Excellent
Average Mean	**4.78**	**Excellent**

Goals and objectives of the game received Excellent ratings across all indicators. Explanation of purpose and rationale scored (mean=4.78), clarity of goals and objectives (mean=4.72), thought-provoking nature (mean=4.84), encouragement of student interaction (mean=4.76), promotion of discussion on key topics (mean=4.82), and support for recall of concepts/terms (mean=4.78). The overall average mean for goals and objectives is (mean=4.78), interpreted as Excellent.

Table 7: Components and Organization Adapted from the study of Sardinola et al.,2025

Indicator	Mean	Interpretation
The directions were clear, concise, and easily understood.	4.58	Excellent
The game emphasizes key points of the topic being played.	4.72	Excellent
The terms used were appropriate to my level of knowledge.	4.74	Excellent
The number of cards was appropriate.	4.74	Excellent
The length of time required to play the game is reasonable.	4.76	Excellent
Average Mean	**4.71**	**Excellent**

Components and organization of the game were rated Excellent across all indicators. Clarity and conciseness of directions scored (mean=4.58), emphasis on

key topic points (mean=4.72), appropriateness of terms to knowledge level (mean=4.74), adequacy of card quantity (mean=4.74), and reasonable playtime length (mean=4.76). The overall average mean for components and organization is (mean=4.71), interpreted as Excellent.

Table 8: Usefulness Adapted from the study of Sardinola et al.,2025

Indicator	Mean	Interpretation
The game was effective in reviewing the material.	4.66	Excellent
The game encouraged deeper exploration of the subject.	4.74	Excellent
Playing the game is a productive use of time.	4.80	Excellent
Playing the game helped build better group relationships.	4.82	Excellent
I would recommend the game to my peers.	4.84	Excellent
Average Mean	**4.77**	**Excellent**

Usefulness of the game was rated Excellent across all indicators. Effectiveness in reviewing material scored (mean=4.66), encouragement of deeper subject exploration (mean=4.74), productivity of playing time (men=4.80), improvement of group relationships (mean=4.82), and willingness to recommend to peers (mean=4.84). The overall average mean for usefulness is (mean=4.77), interpreted as Excellent.

Table 9: Overall descriptive evaluation of Lucky Force

Indicator	Mean	Interpretation
1. Rules and Mechanics of the Game	4.46	Excellent
2. Design of the game	4.68	Excellent
2.1. Graphics	4.52	Excellent
2.2. Size	4.59	Excellent
2.3. Color	4.55	Excellent
2.4. Font size	4.52	Excellent
2.5. Font style	4.66	Excellent
2.6. Physical quality and durability	4.68	Excellent
2.7. Card uniform	4.74	Excellent
3. Conceptual accuracy	4.74	Excellent
3.1. Relatedness to the learning objective	4.73	Excellent

3.2. Accuracy of the content	4.72	Excellent
4. Playability and playfulness	4.77	Excellent
5. Goals and objectives	4.78	Excellent
6. Components and organization	4.71	Excellent
7. Usefulness	4.77	Excellent
Average Mean	**4.67**	**Excellent**

The overall descriptive evaluation of Lucky Force shows all indicators rated as Excellent. Scores are: Rules and Mechanics (mean=4.46), Design (mean=4.68), Graphics (mean=4.52), Size (mean=4.59), Color (mean=4.55), Font Size (mean=4.52), Font Style (mean=4.66), Physical Quality and Durability (mean=4.68), Card Uniformity (mean=4.74), Conceptual Accuracy (mean=4.74), Relatedness to Learning Objective (mean=4.73), Accuracy of Content (mean=4.72), Playability and Playfulness (mean=4.77), Goals and Objectives (mean=4.78), Components and Organization (mean=4.71), and Usefulness (mean=4.77). The overall average mean is 4.67, interpreted as Excellent.

3.2. Science Teacher

The indicators that were used in the overall table from science teachers are the same as from science students

Table 10: Overall descriptive evaluation of Lucky Force

Indicator	Mean	Interpretation
1. Rules and Mechanics of the Game	4.84	Excellent
2. Design of the game	4.82	Excellent
2.1. Graphics	4.69	Excellent
2.2. Size	4.80	Excellent
2.3. Color	4.90	Excellent
2.4. Font size	4.74	Excellent
2.5. Font style	4.81	Excellent
2.6. Physical quality and durability	4.95	Excellent
2.7. Card uniform	4.78	Excellent
3. Conceptual accuracy	4.90	Excellent

3.1. Relatedness to the learning objective	4.98	Excellent
3.2. Accuracy of the content	4.92	Excellent
4. Playability and playfulness	4.72	Excellent
5. Goals and objectives	4.88	Excellent
6. Components and organization	4.65	Excellent
7. Usefulness	4.92	Excellent
Average Mean	**4.83**	**Excellent**

The evaluation indicators of the game were all rated Excellent, with Physical Quality and Durability receiving the highest mean score of 4.95, followed closely by Relatedness to the Learning Objective at (mean=4.98) and Accuracy of the Content at (mean=4.92). Conceptual Accuracy (4.90), Color (mean=4.90), and Usefulness (mean=4.92) also scored very high. Goals and Objectives (mean=4.88), Rules and Mechanics (mean=4.84), and Design of the Game (mean=4.82) followed next, demonstrating strong performance. Font Style (mean=4.81) and Size (mean=4.80) also ranked high, while Card Uniformity (mean=4.78) and Font Size (mean=4.74) received slightly lower but still Excellent ratings. Graphics scored (mean=4.69), Components and Organization (mean=4.65), and Playability and Playfulness had the lowest mean among the indicators at 4.72. Overall, all aspects of the game are highly rated, with Physical Quality, Learning Alignment, and Content Accuracy leading the evaluation.

4. Discussion

The findings, derived from the comprehensive evaluation by both pre-service teachers and experienced science educators, overwhelmingly support the game's effectiveness as a pedagogical tool. The high average mean scores for playability and playfulness (4.77 for students, 4.72 for teachers) confirm that the game's interactive and collaborative elements effectively enhance student motivation and engagement, echoing the findings of Nadeem et al. (2023). The positive feedback on goals and objectives (4.78 for students, 4.88 for teachers), its ability to be "thought-provoking" (4.84 for students), and its promotion of discussion (4.82 for students) highlights the game's capacity to deepen conceptual understanding and knowledge retention, a key benefit of board games identified by Lin et al. (2019) and Ezezika et al. (2021). This also supports the study by Singh et al. (2021), which found that guiding learners through playful activities results in better learning outcomes than traditional instruction by making education an active, not passive, process. In addition, the results of this study are further supported by Gök and Doğan (2025), who emphasized that scientific

curiosity is a fundamental source of motivation and engagement in science education. Their findings highlight that curiosity fosters active participation, positive learning attitudes, and deeper scientific thinking, which align with the way *Lucky Force* encouraged students to explore, question, and apply concepts of net force through interactive gameplay. By stimulating both curiosity and engagement, the game contributes to developing lifelong learning habits in physics education. Furthermore, findings align with Hamari et al. (2016), who found that engagement in the game has a positive effect on learning, while immersion does not significantly influence learning outcomes. Their study also showed that challenge affects learning both directly and through increased engagement, and that skill contributes to learning indirectly by enhancing engagement. This supports the present result that the engaging and challenging mechanics of *Lucky Force* helped sustain student motivation and conceptual understanding of net force through active participation and balanced difficulty.

The game's successful design directly addresses a significant challenge in Philippine science education: the struggle students face with applying formula-based concepts (Sari et al., 2018) and overcoming persistent misconceptions about force and motion (Sarkim, 2024; Liu & Fang, 2016). The "Excellent" average mean score for conceptual accuracy (4.69 for students, 4.90 for teachers) and its sub-indicators—such as relatedness to the learning objective (4.73 for students, 4.98 for teachers) and accuracy of the content (4.72 for students, 4.92 for teachers)—directly demonstrates that "Lucky Force" is an effective tool for presenting scientifically correct information and reinforcing core physics concepts. The high mean scores on indicators like "The game consistently presents concepts in a way that avoids common misconceptions about force" (4.76 for students) and "The outcomes and effects within the game, based on forces, are consistently true to established physics laws" (4.86 for students) provide strong evidence that the game's design successfully translates abstract principles of net force into a tangible, interactive format.

The overall design, including visual elements and physical components, was also rated highly. The game's design was considered "Excellent" by both students (4.68) and teachers (4.82), with particular praise for the use of color (4.55 for students, 4.90 for teachers) and font style (4.66 for students, 4.81 for teachers), which aid in quick comprehension and create an immersive experience (Dzulkifli & Mustafar, 2013; Wood, 2011). The physical quality and durability of the game were also highly regarded (4.68 for students, 4.95 for teachers), ensuring a fair and consistent user experience (Cosimini & Collins, 2023).

The findings on the game's usefulness (4.77 for students, 4.92 for teachers) further highlight its value. The game was seen as a productive use of time (4.80

for students) and was highly recommended by students to their peers (4.84). It also proved effective in building better group relationships (4.82 for students), a finding supported by Sardinola et al. (2022). While the rules and mechanics received the lowest "Excellent" score from students (4.46), and teachers (4.84), this still suggests a high level of satisfaction and only a minor area for potential improvement in clarity or simplicity.

The "Lucky Force" game represents a promising, validated, and innovative approach to addressing critical learning gaps in physics education. The overwhelmingly positive feedback from both students and teachers, across all measured criteria, demonstrates its potential as a valuable GBL tool that effectively combines engagement, conceptual accuracy, and high-quality design to enhance the learning experience.

However, this study has limitations that should be considered. The use of purposive sampling, while providing valuable feedback from individuals with a strong background in science, means that the findings may not be generalizable to the broader population of Grade 8 students. Additionally, the study's descriptive-evaluative design did not include a pre- and post-test component, so it cannot definitively measure the game's direct impact on students' conceptual understanding or compare it to traditional teaching methods.

Future research should focus on a more representative sample of Grade 8 students and incorporate a quasi-experimental design to empirically measure the game's effect on learning outcomes. Longitudinal studies could also be conducted to assess the long-term retention of concepts learned through "Lucky Force." Finally, exploring the scalability of the game and its potential for integration into the official K-12 science curriculum would be a valuable next step.

4. Conclusions

The findings of this study affirm that the *Lucky Force* card/board game is an effective, innovative, and engaging game-based learning tool for enhancing physics education, particularly in the conceptual understanding of net force. Both pre-service teachers and experienced science educators rated the game highly across all evaluation criteria, underscoring its capacity to combine playfulness, conceptual accuracy, and quality design in a way that fosters motivation, collaboration, and knowledge retention. The consistently "Excellent" ratings for conceptual accuracy and relatedness to learning objectives highlight its ability to present scientifically correct information while addressing persistent misconceptions in force and motion.

While the study provides strong evidence of the game's pedagogical value, its limitations—such as the purposive sampling method and the absence of pre- and post-test measures—restrict the generalizability and causal interpretation of the findings. Future research should employ a more representative sample of Grade 8 students, utilize quasi-experimental designs, and explore longitudinal

impacts on learning retention. Additionally, examining the game's scalability and integration into the new MATATAG science curriculum could further enhance its educational relevance and reach.

Acknowledgements

Collate acknowledgements in a separate section at the end of the article before the references. List here those individuals who provided help during the research (e.g., providing language help, writing assistance or proof reading the article, etc.).

References

Alam, G. M. (2023). Has secondary science education become an elite product in emerging nations?—A perspective of sustainable education in the era of MDGs and SDGs. *Sustainability, 15*(2), 1596. https://doi.org/10.3390/su15021596

Balagtas, M. U., Garcia, D. C. B., & Ngo, D. C. (2019). Looking through Philippine's K to 12 curriculum in Mathematics and Science vis-a-vis TIMSS 2015 assessment framework. *EURASIA Journal of Mathematics, Science and Technology Education, 15*(12), em1788. https://doi.org/10.29333/ejmste/109599

Bouzid, T., Kaddari, F., & Darhmaoui, H. (2022). Force and motion misconceptions' pliability: The case of Moroccan high school students. *The Journal of Educational Research, 115*(2), 122–132. https://doi.org/10.1080/00220671.2022.2064802

Chen, L., Zeng, S., & Wang, W. (2021). The influence of emotion and learner control on multimedia learning. *Learning and Motivation, 76,* 101762. https://doi.org/10.1016/j.lmot.2021.101762

Cosimini, M. J., & Collins, J. (2023). Card and board game design for medical education: Length and complexity considerations. *Korean Journal of Medical Education, 35*(3), 291–296. https://doi.org/10.3946/kjme.2023.271

De Melo, R. J., Adams, F. W., & Nunes, S. M. T. (2020). Concepções da importância do ensino de ciências na educação básica por licenciandos de um curso de educação do campo. *Revista Brasileira De Educação Do Campo, 5,* e7240. https://doi.org/10.20873/uft.rbec.e7240

Dzulkifli, M. A., & Mustafar, M. F. (2013). The influence of colour on memory performance: A review. *Malaysian Journal of Medical Sciences, 20*(2), 3–9.

Ezezika, O., Fusaro, M., Rebello, J., & Aslemand, A. (2021). The pedagogical impact of board games in public health biology education: The Bioracer Board Game. *Journal of Biological Education, 57*(2), 331–342. https://doi.org/10.1080/00219266.2021.1909638

Gök, F. S., & Doğan, A. (2025, August 7). *A Science Curiosity Scale for Middle school students: A Validity and Reliability study: A Science Curiosity scale*. https://ijci.net/index.php/IJCI/article/view/1675

Hamari, J., Shernoff, D. J., Rowe, E., Coller, B., Asbell-Clarke, J., & Edwards, T. (2015). Challenging games help students learn: An empirical study on engagement, flow and immersion in game-based learning. *Computers in Human Behavior*, *54*, 170–179. https://doi.org/10.1016/j.chb.2015.07.045

Hejazi, F., & Chun, T. K. (2020). Introduction. In *Advanced structured materials* (pp. 1–6). https://doi.org/10.1007/978-981-15-5440-7_1

Lin, Y., Huang, S. W., & Chang, C. (2019). The impacts of a marine science board game on motivation, interest, and achievement in marine science learning. *Journal of Baltic Science Education, 18*(2), 234–246. https://doi.org/10.33225/jbse/19.18.234

Liu, G., & Fang, N. (2016). Student misconceptions about force and acceleration in physics and engineering mechanics education. *International Journal of Engineering Education, 32*(1), 19–29.

Métioui, A., & Trudel, L. (2021). Children and preservice teachers' misconceptions and scientifically acceptable conceptions about movement, force, and gravity. In *Misconceptions in primary science* (pp. 26–42). Book Publisher International. https://doi.org/10.9734/bpi/mplle/v5/9032d

Mikrouli, P., Tzafilkou, K., & Protogeros, N. (2024). Applications and learning outcomes of game-based learning in education. *International Educational Review, 1*(1), 25–54. https://doi.org/10.58693/ier.212

Molin, G. (2017). The role of the teacher in game-based learning: A review and outlook. In *Serious games and edutainment applications* (pp. 649–674). Springer. https://doi.org/10.1007/978-3-319-51645-5_28

Nadeem, M., Oroszlanyova, M., & Farag, W. (2023). Effect of digital game-based learning on student engagement and motivation. *Computers, 12*(9), 177. https://doi.org/10.3390/computers12090177

OECD. (2023). Philippines – Country note: PISA 2022 results. *Education GPS*. https://gpseducation.oecd.org/CountryProfile?primaryCountry=PHL&threshold=5&topic=PISA

Sardinola, C. F. C., Malayao, S. O., Jr., Paylaga, G. J., Sayson, N. L. B., Arogancia, D. C., & Caparoso, J. K. V. (2025). "Spectro-Uno": Development and evaluation of card game material in learning light for Grade 8 students. *International Journal of Research and Innovation in Social Science, 9*(3), 4537–4544. https://doi.org/10.47772/IJRISS.2025.90300363

Sari, A. L. R., Parno, P., & Taufiq, A. (2018). Pemahaman konsep dan kesulitan siswa SMA pada materi hukum Newton. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan, 3*(10), 1333–1339. https://doi.org/10.17977/jptpp.v3i10.11663

Sarkim, T. (2024). Misconceptions about acceleration among prospective physics teachers: The importance of discussion of acceleration as a vector quantity. *International Journal of Applied Sciences and Smart Technologies, 6*(1), 41–52. https://doi.org/10.24071/ijasst.v6i1.8231

Singh, P., Teoh, S. H., Nasir, A. M., Ramly, A. M., Rasid, S. M., & Chew, C. M. (2021). Card game as a pedagogical tool for numeracy skills development. *International Journal of Evaluation and Research in Education, 10*(2), 693–705. https://doi.org/10.11591/ijere.v10i2.20722

Wood, D. (2011). *How children think and learn* (2nd ed.). Wiley-Blackwell.